FY98 STATUS REPORT TO SERDP
Project CS-507: Threatened, Endangered, and Sensitive Resources:
Smokes and Obscurants
Keturah Reinbold, PI
USACERL
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This report is a summary of accomplishments during the FY98 fiscal year and current status of ongoing project efforts.

Chemical Analysis Method for Fog Oil Obscurant

Work is proceeding on the more specific chemical analysis method for fog oil. In most previous studies analyses were performed for total oil (no distinction of fog oil from other oils) or looked for certain priority pollutant compounds found in petroleum. A more specific fingerprint for fog oil is needed for the fog oil used in laboratory studies for this project and for field studies. Related protocols were examined, and elemental analysis (carbon, hydrogen, nitrogen, and sulfur) were completed for fog oilsamples from two different batches used in laboratory studies as well as an old fog oil sample for reference. A preliminary fingerprint by gas chromatography-mass spectrometry (GC/MS) has been completed. Method development and analysis for a more complete characterization will be completed in the first quarter of FY99.

Smoke Dispersion Model Integration with GIS

To predict effects of smokes, it necessary to know not only what concentrations of the smoke may cause effects but also whether the endangered species of concern will be exposed to those concentrations. Thus for the military decision-maker to decide whether to proceed with a smoke release, it is important to predict the concentration at the location of the endangered species of concern.

An appropriate dispersion model can provide the prediction of concentrations. For the model to be easy to use it must have a user-friendly interface. Also, capability to use existing installation GIS files to provide installation-specific data input and to accept and display the model data output greatly improves ease of use. USACERL is developing this tool for military users and will make it available via the internet.

For the smokes and obscurants dispersion internet tool, USACERL previously developed a user interface and a functional interface between GIS and a simple Gaussian dispersion model. During FY98, a contractor made substantial progress toward developing the improved dispersion model to be put on the Web site. It is an upgraded, generalized version of the SMOKE dispersion model. This model was selected by USACERL after an extensive review of existing dispersion models, focusing particularly but not exclusively on models developed for military use, as the one most complete in terms of our specific requirements and most suitable and readily

adaptable to application for use by military installation personnel. It was the only dispersion model with sufficient inclusion of capabilities for our purposes which included information specific for fog oil smoke and had been validated for it. Fog oil smoke is our test case among smokes and obscurants because it is of primary concern to the military. Independently from the USACERL evaluation, the Army Environmental Center (AEC) selected this model for use to predict fog oil dispersion for U.S. EPA permit application at Fort Leonard Wood.

The SMOKE model was developed and validated for fog oil and hexachloroethane (HC) smokes by Professor William Dunn and Dr. David Brown and associates of the University of Illinois Department of Mechanical Engineering and Argonne National Laboratory. Two previous site-specific versions of the SMOKE model were developed. The first model was developed for the Army at Fort McClellan, AL (location of the Army's Chemical School) for predicting smoke dispersion just prior to release. The second version of the model was provided to Fort Leonard Wood (the future location of the Army's Chemical School) for application for a U.S. EPA permit for future fog oil releases at the Chemical School; this model predicted dispersion based on averages of five years of meteorlogical data.

Professor Dunn, Dr. Brown and associates are now developing the new version of the SMOKE model which can accept data for any location. This model addresses the need to predict the dispersion of smokes from the point(s) of release based on meteorological information which is available only hours before the actual release is intended to occur. It is an "Operational Model", i.e., intended for use for planning purposes at or near the time of a smoke release, as opposed to a version of the model used for obtaining a permit for future smoke/obscurant releases.

USACERL divided the previous Web interface into a configuration which would now be able to handle both existing models depending on user requests. We have supplied to Professor Dunn's staff supporting data which is required to run his model and have implemented a user friendly Web interface to accept inputs for the Operational model.

A summary of this work was presented at the International Conference on Applications of Scientific Computing in June of 1998 in Alicante, Spain. The manuscript is currently awaiting publication.

Laboratory Toxicity Studies

Additional laboratory toxicity studies were performed in FY98. Again the focus has been on birds (because no previous inhalation studies have been performed on birds and many of the endangered species of concern are birds) and, in particular, on fog oil (indicated by endnagered species user group as the smoke/obscurant of greastest concern). Previous studies used bird species which are surrogates for the Red-cockaded Woodpecker (RCW) because it is the species of greatest concern. Both adult birds (red-winged Blackbird, body weight surrogate) and nestlings (starlings, cavity nesting altricial species surrogate) in an RCW nest cavity were exposed to fog oil aerosol. No significant effects were observed.

During FY98, we investigated whether there may be more subtle, long-term effects of fog

oil which could affect population status. Investigations focused on physiological development of birds to the reproductive state and immunotoxic effects. Data is being analyzed. Also, additional nestlings were exposed to fog oil aerosol to verify previous results. Preliminary exposures of fertile bird eggs to fog oil aerosol and to fog oil were also performed to determine whether there may be effects on development of embryos. These tests will be completed in FY99.

Presentations

"Methods for Assessing Risks to Threatened and Endangered Species from the Use of Smokes and Obscurants on Military Training Areas." K. Reinbold G. Suter, B. Sample, J. Day, and B. Stenson. Presented by K. Reinbold at the Annual Meeting of the Society of Environmental Toxicology and Chemistry, November 1997, San Francisco, CA.

"Chemical Analysis of Military Obscurant Fog Oil". Jean Day, Patricia Kemme, Donald Cropek, and Keturah Reinbold. Presented by J. Day at The Pittsburgh Conference, New Orleans, Louisiana, 1- 5 March 1998

"Modeling Environmental Impacts Over the Internet: Smoke Dispersion Prototype". Robert C. Lozar, Keturah Reinbold, W.E. Dunn and D. F. Brown. Presented at the International Conference on Applications of Scientific Computing, June 1998, Alicante, Spain.
(The manuscript is currently awaiting publication.)

Reports

Methods for Field studies of Effects of Military Smokes, Obscurants, and Riot-Control Agents on Threatened and Endangered Species. Vol. 3: Strategies for Developing a Statistically Sound Approach. D. Cassels, A. Krzysik, and K. Reinbold
Status: in revision; final version will be published in FY99

Methods for Field studies of Effects of Military Smokes, Obscurants, and Riot-Control Agents on Threatened and Endangered Species. Vol. 4: Chemical Analytical Methods. S. Nam, M. Walsh, J. Day, and K. Reinbold.
Status: revision in funal editing stage prior to publication.

"Acute Inhalation Toxicity of Fog Oil Smoke in the Red-winged Blackbird (*Agelalus phoeniceus*), a Weight-Specific Inhalation Surrogate for the Red-cockaded Woodpecker (*Picoides borealis*)." C. Driver, M. Ligotke, H. Galloway-Gorby, G. Dennis, and K. Reinbold.
Status: report completed; will be published in FY99.

"Ecological Risk Assessment of the Effects of Military Fog Oil Obscurant on the Red-cockaded Woodpecker."
Status: report in preparation; problem formulation section completed; analysis section partially prepared, awaiting results of recently completed and ongoing laboratory studies; risk characterization section pending lab data.

Environmental Behavior, Fate, and Effects of Military "new" Fog Oil on Soil and Aquatic Ecosystems". K. Reinbold, J. Day, D.Ferber, M. Stees, B.Stenson, and K. Charleston. Status: in final stages of preparation prior to technical editing.